Freshwater Quality Monitoring Protocol
San Francisco Area Network

Standard Operating Procedure (SOP) # 3

EQUIPMENT AND FIELD PREPARATIONS

Version 1.01

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Only changes in this SOP will be logged. "Version numbers increase incrementally by hundredths (e.g. version 1.01, version 1.02, …etc) for minor changes. Major revisions should be designated with the next whole number (e.g., version 2.0, 3.0, 4.0 …). Record the previous version number, date of revision, author of the revision, identify paragraphs and pages where changes are made, and the reason for making the changes along with the new version number" (Peitz et al, 2002).

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Acknowledgements

Several other Standard Operating Procedures and technical guidance were consulting while writing this SOP. The overarching guidance is from the USGS National Field Manual. In addition, *Procedures for Collection of Required Field Parameters, Version 1.0, Standard Operating Procedure #5* (O'Ney, 2005), the *Crissy Field Restoration Monitoring Program Quality Assurance Project Pla*n (Ward, 2004), and the *Quality Assurance Management Plan for the State of California's Surface Water Ambient Monitoring Program ("SWAMP")* (Puckett, 2002) were also consulted for guidance on specific parameters, instruments, or methods. Finally, equipment log sheets and the equipment technical support guide were compiled by Amelia Ryan. Much appreciation is extended to the individuals involved in the production of these documents.

1.0 SCOPE AND APPLICATION

1.1 Introduction

Field measurements should represent the natural condition of the surface water at the time of sampling. Equipment calibration and maintenance will help ensure that field measurements reflect the actual site conditions as closely as possible. Keeping routine records of equipment calibrations, maintenance, and repair is an integral part of QA/QC efforts in the water quality monitoring program. In addition knowledge of expected stream conditions is necessary in order to determine whether field measurements are accurate or equipment is out of calibration.

This SOP will follow guidelines provided by equipment manufactures (e.g., Oakton, YSI, Inc., Marsh-McBirney) for equipment operation and maintenance as well as calibration guidelines outlined in the USGS National Field Manual. This includes calibration methods and frequency, equipment cleaning, changing pH electrodes, D.O. membranes, etc. Procedures for dealing with deficient equipment are also discussed and include preventative maintenance procedures and schedules to minimize downtime of sampling and measurement equipment. Information on spare parts, batteries and contingency plans for equipment back-up is also provided.

To minimize or avoid downtime of measurement instruments, all field sampling and laboratory equipment will be maintained in good working order. Also, spare equipment or common spare parts (e.g., batteries, D.O. membranes, pH electrodes) will be available so that repairs or replacement can be made as quickly as possible and measurements will not be lost. All field equipment having manufacturer-recommended schedules of maintenance will receive preventive maintenance according to that schedule (see Table 11). Other equipment used only occasionally will be inspected. at least monthly. After use in the field, all equipment will be re-checked for needed maintenance.

An instrument or device used in obtaining an environmental measurement must be calibrated by the measurement of a standard. Every instrument or device has a specialized procedure for calibration and a special type of standard used to verify calibration. See instrument manuals for further details. A log book will be kept to record dates of calibration and any equipment errors or failures, battery changes, changes of calibration solutions, and repair notes. The log book will also contain calibration methods, this schedule of inspections and calibrations, and a list of needed supplies and equipment.

2.0 EQUIPMENT CALIBRATION, INSPECTION, AND MAINTENANCE

Overview of Calibration Tasks:

- Field instruments calibration and maintenance should be logged in the equipment binder. Items to log include the date of calibration, any change of calibration solutions, changed batteries, D.O. membranes, pH electrodes, date and description of repairs conducted by the manufacturer.
- The log book should be reviewed before leaving for the field.
- Each instrument (meters and sensors) should be tested before leaving for the field.
- Measurement technique should be practiced if the instrument is new to the operator.
- Backup instruments should be readily available and in good working condition.

Table 1. Calibration schedule (O'Ney, 2005)

Parameter	Calibration Frequency	Acceptance Criteria	Corrective Actions
Temperature Liquid-in-glass thermometer:	Every 3 to 6 months, using a 2-point calibration, and annually, using a 3-point calibration 10% of the readings taken each day must be duplicated, or a minimum of 1 reading if fewer than 10 samples are read.	±1.0 ºC	Re-test with a different thermometer; repeat measurement
Temperature Thermistor thermometer:	Every 3 to 4 months, check calibration, annually, using a 5-point calibration	Same as above	Re-test with a different thermometer; repeat measurement
Specific Conductance	Prior to field mobilization, at the field site, and calibration check at day's end; 10% of the readings taken each day must be duplicated or a minimum of 1 reading if fewer than 10 samples are read.	±5%	Re-test; check low battery indicator; use a different meter; use different standards; repeat measurement
Dissolved oxygen	Prior to field mobilization, at the field site, and calibration check at day's end	±10%	Re-enter altitude; re-test; check low battery indicator; check membrane for wrinkles, tears or air bubbles; replace membrane; use a different meter; repeat measurement
Hydrolab ® minisonde datalogger	Beginning and end of each deployment	See manual	
pH meter	Prior to field mobilization (three point calibration using buffer solutions (pH 4,7, and 10)) At the field site, and calibration check at day's end (one point calibration) 10% of all reading taken each day must be duplicated or a minimum of 1 reading if fewer than 10 samples are read.	±0.05 pH unit; ±0.1 pH unit RPD ±0.1 pH unit	Re-test; check low battery indicator; use different standards; repeat measurement

Notes on Table 1
-All instrument should be visually inspected before use
-Check batteries before use
-Rinse all equipment after use
-Insure that pH electrodes and D.O. membrane remain moist

2.1 Multiparameter instrument (dissolved oxygen and conductivity)

Network staff should consult the manufacturers' instruction manual for detailed calibration procedures for multiprobe instruments (Appendix A). All calibration and maintenance activities must be recorded in a Calibration Logbook (see Appendix D). The minimum calibration schedule and calibration acceptance criteria are in Table 1 above. General guidelines for conductivity and dissolved oxygen are provided below.

- D.O. (and conductivity) should be calibrated before each site;
- Clean sensors thoroughly with deionized water (DIW) before and after making a measurement (this is sufficient cleaning in most cases)
- Rinse and clean (use tiny brush) YSI 85 with tap water.
- Remove oils or other chemical residues (salts) with detergent (soak in solution of water and detergent)
- If these residues persist, then, a chemical (acid) recommended by YSI may be used
- Always calibrate from low to high specific conductance
- Calibrate at the field site – bring conductivity standards to water sample temperature
- Record the sources of calibration standards; standards should be traceable to a source such as NIST (National Institute of Standards and Technology or EPA certified vendors.
- Never re-use standards or use expired standards
- For short-term storage (days to a couple weeks): ensure that sponge in probe chamber remains saturated; have extra (unused) sponges available
- For longer term storage (2 weeks or more): remove all sensors from the multiprobe and store per manufacturers instructions; store clean and dry
- Ensure that conductivity standards are clearly labeled with the expiration date. Never used an expired solution to calibrate
- All instruments must meet the calibration error limits stated in Table 1
- Record all calibration and maintenance activities in the log book
- The Winkler titration method is used as a back-up if the oxygen sensor fails in the field. It can also be used to calibrate D.O. in the laboratory. It is a good idea to practice this method in the laboratory before the possibility of needing to use it in the field. See SOP#5 for details about the technique.

On an annual basis, place all the probes in the same bucket, leave them a minute to equilibrate, and then compare the readings. Sometimes they will not give identical readings. If so, note the differences and correct.

Consult the YSI manual for details on how to calibrate conductivity and dissolved oxygen and how to clean the conductivity cell and dissolved oxygen sensor. If chemicals are necessary for D.O. probe/conductivity cell cleaning, review the chemicals' MSDS for required handling and disposal. Also consult the MSDSs for conductivity standards.

2.2 Thermometer/Thermistor

(from USGS National Field Manual Ch. 6.1)

Accurate determination of other field measurements depends on accurate temperature measurements. This is particularly important for thermistors incorporated in specific electrical conductance and dissolved-oxygen instruments, such as the hand-held YSI 85. These thermistors are used for automatic temperature compensation of the measurements being made. Thermistors included in other field-measurement instruments must be calibration checked routinely.

The thermistor in the YSI 85 multiprobe should be checked for accuracy against a NIST certified thermometer by Network staff upon receipt from the manufacturer and at a minimum quarterly thereafter (see procedure below). The thermistors should be checked against a broad range of temperatures (e.g. from an ice water bath to beyond the range water body temperatures are expected to be encountered in the field; e.g. 45°C). Conduct an annual 5-point calibration .

If a temperature probe is found to not meet the temperature calibration requirements set forth in the Table 3, the entire multiprobe should be returned to the manufacturer for replacement. Once calibrated by the manufacturer, thermistor thermometers are one of the more accurate and stable sensors requiring the least maintenance. Multiparameter instruments are generally equipped with a thin-walled, titanium-sleeved thermistor that offers fast response and resists corrosion. The device is of high precision (e.g. 2252 ohms @ 25° C w/precision of ± 1%) and uses an imbedded algorithm to convert resistance to temperature. When handled according to manufactures specifications, and checked on a regular basis, the sensor should provide a long period of useful operation. Radtke et al.(1998) detail the proper calibration and documentation for thermometers and thermistor thermometers.

All temperature measurements should be made and reported in units of degrees Celsius (°C). Each Network lab should be equipped with a NIST certified digital calibration thermometer (preferred) or a liquid-in-glass thermometer graduated at 0.1 °C with a minimum range of –5 to + 45 °C. Prior to conducting fieldwork, temperature sensors used should be tested against thermometers certified by the National Institute of Standards and Technology (NIST) for lab testing of temperature equipment. A second NIST certified digital thermometer may also be appropriate for field use and may best serve to field check the thermistor-based measurements of the multiprobes and measure ambient air temperatures when at the monitoring station.

CALIBRATION EQUIPMENT

- Calibration thermometer, liquid-in-glass sensor, certified by NIST
    - Temperature range at least –5 to +45°C
    - 0.1°C graduated
- Thermometer, liquid-in-glass sensor
    - Temperature range –5 to +45°C
    - Minimum 0.5°C graduated
    - Calibrated accuracy within 1 percent of full scale or 0.5°C, whichever is less
    - Calibrated and certified against calibration (NIST) thermometer
- Thermistor thermometer
    - Calibrated accuracy within 0.1°C to 0.2°C
    - Digital readout to at least 0.1°C

  - Calibrated and GRYN certified against calibration (NIST) thermometer
- Soap solution (1 L), nonphosphate laboratory detergent
- Deionized water (1 L), maximum conductivity of 1 mS/cm
- Paper tissues, disposable, soft, and lint free (e.g., ChemWipes)
- Log book, for recording all calibrations, maintenance, and repairs

CALIBRATION PROCEDURE

The standard thermometer against which all other thermometers are calibration checked must be NIST certified. It must be accurate to 0.1°C. Check the certificate of calibration for the NIST thermometer before calibrating field thermometers. NIST-certified thermometers are not for field use.

Thermometers being calibration checked must meet NIST specifications to a minimum of three temperatures at approximately 0°, 25°, and 40°C. Thermistors must be calibration checked at 5 points within this range. If environmental water or air temperatures will fall below 0°C or rise above 40°C, add additional calibration points to bracket the temperatures to be measured. Field checking thermometer calibration by comparing readings with another field thermometer does not substitute for required laboratory calibration procedures. When measuring water temperature in the laboratory:

1. Submerge the bulb and liquid column of the total-immersion thermometer.
2. Keep the NIST-certified thermometer and the thermistor sensor submerged in the container throughout calibration.
3. Read the NIST-certified thermometer and record the thermistor readings throughout warming and cooling periods.
4. Check the meter batteries periodically for proper voltage.
5. Record the calibration data in the instrument log book for each thermistor thermometer, noting if a sensor has been replaced.
6. Tag acceptable thermometers as “SFAN certified” with calibration date and certifier’s initials.

The following procedure will be used to calibrate to0°C :

1. Freeze several ice cube trays filled with deionized water.
2. Fill a 1,000-mL plastic beaker or Dewar flask three-fourths full of crushed, deionized ice. Add chilled, deionized water to the beaker. Place the beaker of ice/water mixture in a larger, insulated container or Dewar flask. Place the NIST-certified thermometer into the ice/water mixture and make sure that the temperature is uniform at 0°C by stirring and checking at several locations.
3. Pre-cool the test thermometer sensor to 0°C by immersing it in a separate ice/water bath.
4. Add the test thermometer sensor(s) to the ice/water mixture. Position the sensor(s) so that they are properly immersed and so that the scales can be read. Periodically stir the ice/water mixture and allow at least 2 minutes for the thermometer readings to stabilize.
5. When the readings stabilize, compare the temperature of one test thermometer at a time with that of the NIST-certified thermometer. Without removing the temperature sensor(s) from the test bath, read the test thermometer(s) to the nearest graduation (0.1 to 0.5°C) and the NIST-certified thermometer to the nearest 0.1°C.
   - Take three readings for each thermometer within a 5-minute span.
   - Calculate the mean of the three temperature readings for each thermometer and compare its mean value with the NIST thermometer.

- If the test liquid-filled thermometer is found to be within ±1 percent of full scale or ±0.5°C of the NIST-certified thermometer, whichever is less, set it aside for calibration checks at higher temperatures.
- If the test thermistor is found to be within ±0.2°C of the NISTcertified thermometer, set it aside for calibration checks at higher temperatures.

6. For "room temperature" calibration (about 25°C), place a Dewar flask or container filled with about 1 gallon of water in a box filled with packing insulation. (A partially filled insulated ice chest can be used for multiparameter instruments.) Place the calibration container in an area of the room where the temperature is fairly constant (areas away from drafts, vents, windows, and harsh lights).
7. Properly immerse the NIST-certified and test thermometer sensor(s) in the water. Cover the container and allow the water bath and thermometers to equilibrate. Stir the water and check every couple of hours for temperature uniformity using the NIST certified thermometer—it may be necessary to let the bath equilibrate overnight.
8. Compare one test thermometer at a time with the NIST-certified thermometer. Calibrate as described in step 5 above.

- For greater than 25°C temperature calibration, place a beaker (1,000 mL or more) of warm water (about 40°C) on a magnetic stirrer plate and repeat procedure as described in step 5 above.
- Tag acceptable thermometers as "Certified" with calibration date and certifier's initials.
- Record procedure in calibration logbook.

Corrections can be applied to measurements made with a thermistor instrument system if necessary, using a calibration curve or table plotted in the log book. Thermometers found to be out of calibration by more than 0.2°C must be recalibrated per manufacturer's instructions or returned to the manufacturer for proper calibration and (or) repairs.

Thermometers can easily become damaged or out of calibration. Take care to:

- Keep thermometers clean (follow manufacturer's recommendations).
- Carry thermometers in protective cases; thermometers and cases must be free of sand and debris.
- Store liquid-filled thermometers in a bulb-down position and in a cool place away from direct sunlight.
- As an additional precaution on field trips, carry extra calibrated thermometers as spares, and a supply of batteries for instrument systems
- Never carry a mercury-filled thermometer in the field.

2.3 pH Meter

(adapted from the Surface Water Ambient Monitoring Program Quality Assurance Management Plan (Puckett, 2002) and USGS National Field Manual Ch. 6.4)

Because a large variety of pH meters and electrodes are available on the market, it is very important to be thoroughly familiar with the instruction manual provided by the manufacturer. Electrodes must be clean and properly operating to produce accurate results. The liquid junction also must be free flowing, and the electrolyte solution in the electrode must be at the proper level. Because of the variety of electrodes available, follow the cleaning and storing instructions provided by the manufacturer. In this case, SFAN will be using the Oakton pH Testr 3+. It is a waterproof meter requiring four A76 batteries. See the appendix for manufacturer recommended calibration and maintenance.

When single function pH meters are used, pH is calibrated for each day of use, and at each sampling site. Additional calibrations may be necessary if questions arise regarding a particularly measurement. The pH meter should be calibrated with a buffer of pH 7.0 and either 4.0 for naturally acidic waters or pH 10.0 for alkaline waters. The pH of SFAN waters is generally between 6.5 and 8.5. The pH buffers contain high concentrations of phosphate. Care must be taken during calibration to avoid leaving traces of buffer on equipment or at the work place that could contaminate water samples. Buffer solutions prepared in the field offices from reagent powder or concentrate are labeled with date of preparation and replaced after one month (Puckett, 2002).

- Ensure that the pH electrode remains moist at all times.
- Rinse and clean (use tiny brush) pH meter with tap water
- Never wipe the pH electrode membrane with anything or store it dry (check manufacturer's instructions)
- Record any operation difficulties, batteries changed, or pH electrodes changed in the equipment log book
- Check MSDS for pH buffer solutions
- Always cap the buffer solutions to prevent evaporation and contamination from atmospheric carbon dioxide
- Take care not to dilute a buffer (e.g., with water dripping from a sensor) or contaminate with another buffer
- Never pour used buffer into a stock solution bottle or allow anything else to enter the stock bottle
- Discard buffers on their expiration date; copy the expiration data onto any container into which the buffer is transferred
- Calibrate before heading to the field and at each site
- Calibrate as close to the temperature of the water body as possible*

Buffer solutions in the calibration kit that are taken from the stock bottle should be replaces by new solution from the stock bottle at least weekly.

The table in the Appendix B demonstrates how pH calibration standards differ based on temperature. A bucket can be used to place the calibration standards (capped) in while they equilibrate with the sample water temperature (approximately 15 minutes). “The more modern instrument are equipped with microprocessors that perform autocalibration operations that automatically compensate for buffer temperatures by deriving the Nernst slope”(Penoyer, 2003).

2.4 Post-Calibration Checks

From *Procedures for Collection of Required Parameters*, *SOP#5* by O’Ney (2005)

Post-calibration checks must be performed after each use of the instrument and before any instrument maintenance. The sooner this procedure is performed, the more representative the results will be for assessing performance during the preceding field measurements. Calibration and post-calibration should be no more than 24 hours apart. Take the same care used in performing the initial calibration by rinsing the sensors and waiting for functions to stabilize. After making measurements at the last station, fill the sampling cup with ambient water (not deionized or tap water). Repeat the initial calibration procedures performed before the sampling trip. Record post-calibration values in a Calibration Logbook (generally on the same page with the initial calibration for that sampling trip).

Do not adjust the instrument (using calibration controls) during the post-calibration check. The purpose of the post-calibration is to determine if the instrument has held calibration during the day of sampling. Compare the post-calibration values to the expected values for the standards, so the field measurements for the day can be reported with confidence. The difference between the post-calibration value and expected standard value can be used to indicate both calibration precision and instrument performance.

Post-Calibration Check Error Limits

If post-calibration values (Table 2) fall outside the error limits for DO, pH, and specific conductance, data collected does not meet quality assurance (QA) and should not be reported. If post calibration measurements do not consistently fall within the error limits after in-house trouble shooting, the instrument should be returned to the manufacturer for maintenance.

Table 2. Post-Calibration Check Error Limits

PARAMETER	**VALUE**
Temperature	± 1 °C, annual calibration check
Specific Conductance	± 5%
pH	± 0.5 standard units
Dissolved Oxygen	± 0.5 mg/L, ± 6% saturation

2.5 Continuous Monitor (Hydrolob Minisonde)

Procedures for calibration and cleaning of the Hydrolab® Minisonde are outlined in Appendix C. Calibration steps are divided in four parts: pre-field calibration, post field calibration, cleaning, and downloading. The manual can be found at: http://www.hachenvironmental.com/pdf/Series_4a_Manual.pdf

Some of the QA/QC measures for conductivity and dissolved oxygen, temperature, and pH are embedded in the sections above. The following are QA/QC measures are from the Crissy Field Restoration Monitroing Program Quality Assurance Project Plan (Ward, 2004):

- ♦ Never accept any calibration for which you have received a warning message. Determine and correct the cause of the problem and re-calibrate.
- ♦ Don't use expired standards and use fresh solutions for calibration. Probes may be rinsed with expired solutions,
  but not calibrated.
- ♦ Replace the D.O. membrane before each deployment, allowing te probe to sit at least 6 hours after replacement before pre-field calibration and deployment.

2.6 Equipment and Supplies: Maintenance and Storage

The following is a guide for maintaining calibration standards and other solutions and supplies. Although some samples have an extended shelf life, they should be replaced when they exceed the manufacturers expiration date.

Table 3. Storage time for calibration standards

Item	**Shelf Life**
Conductivity standards	1.5 years
pH buffer solution in small bottle	1 month in small container
pH buffer solution in stock container	Expiration data stamped on bottle
pH buffer powder	Indefinite
D.O. electrolyte crystals or solution	indefinite

The following information applies to Hydrolab instruments.

Long Term Storage

Field instruments are often stored for indefinite periods. For example, back-up instruments are used during repair of the primary instrument. The instrument cannot be kept in a perpetual state of readiness without regular maintenance.

Whenever multiprobes are to be stored for extended periods of time:

- Thoroughly clean the sensors.
- Remove installed batteries (AA batteries, C batteries, polarizing batteries).
- Fill the storage cap about 3 full of tap water (if the multiprobe may be exposed to freezing temperatures a solution of 2 tap water and 2 methanol should be used).
- Store away from direct sunlight. ----The instrument can be reliably reactivated for field use with minimum of effort the day before field use.

(From the State Water Resources Control Board Surface Water Ambient Monitoring Program (SWAMP) Part of Appendix E Quality Assurance Management Plan)

3.0 FIELD PREPARATIONS

The network Water Quality Specialist (Hydrologist/Physical Scientist) will determine which lab will be used for the sampling event. Analytical laboratories often have different constraints on the number of samples they can process and the days and times that they can accept samples. The laboratory should be notified of the sampling event as soon as possible. Information to be provided includes the number of sites and times/days that samples will be collected, what parameters will be analyzed, and any courier services needed. This gives ample time for the laboratory to provide sample bottles and other supplies (coolers, blue ice, labels, COC forms). Chain of Custody (COC) forms should be completed and faxed to the chosen laboratory at least one day prior to sampling or as required by the laboratory. Call the lab in advance (1-2 weeks or more) to schedule a sample pick-up or drop-off and notify the lab of the # of samples and analyses required. In addition, call the lab the morning of the sampling to verify.

A number of steps should be taken at the office to insure that all of the equipment is in the vehicle. Be sure to use the following checklist for equipment inventory.

√	**Equipment for Collecting Required Field Parameters**
	Calculator (for calculating centroid of flow)
	Bacteria bottles: Sterile 100 mL bottles (provided by lab)
	Nutrient bottles: Sterile sample bottles, (provided by lab)
	Sediment bottles: 500mL or 1-liter sample bottles (CLEAN!)
	Sharpie, pen, pencil
	Clipboard
	Field collection data sheets (on Rite in Rain paper if necessary)
	Labels from laboratory
	Labels for sediment bottles (and nutrient bottles if necessary)
	Chain of Custody
	Disposable rubber gloves
	Paper towels or rag for drying bottles before labeling
	YSI 85 or (YSI 30 and YSI 55) multiparameter probes
	Extra AA batteries (6) for YSI meter
	pH meter*
	Extra pH meter or pH tape at the very least
	PH meter batteries (four A76 watch batteries)
	1-3 Large coolers
	I small cooler
	Blue ice
	Flow meter and extra D batteries
	Top-setting wading rod
	50m measuring tape
	Chaining pins (or similar)
	Waders/rubber boots
	Radio or cell phone (depending on location)
	Keys and/or combinations for gate locks, dataloggers
	Water jugs with tap water for rinsing boots
	Water jug with distilled water for rinsing pH electrodes and YSI probe
	All maintenance log books and calibration standards for all field equipment
	Digital camera with optional waterproof case
	GPS unit
	Hand sanitizer and/or antibacterial soap
	All maintenance parts and calibration standards for field equipment
	NIST calibrated Centigrade thermometer for air temp
	NIST calibrated Centigrade thermometer for back-up
	Winkler titration kit for D.O. back-up
	Stopwatch and headset for discharge measurements
	Personal flotation device
	Traffic safety vest, cones, signs, warning lights
	First aid kit
	Highway emergency kit
	Tool kit
	Tape (electrical, fiber, other)
	Fire extinguisher
	Flashlight with extra batteries
	Weather report
	Field trip itinerary
	Work gloves
	Drinking water
	Copy of safety SOP
	Maps
	Deionized water

4.0 QA/QC PROCEDURES FOR EQUIPMENT

Table 4. QA protocols

Measurement Parameter	QA Protocol
pH	Equipment blanks,
Dissolved oxygen	Equipment blanks
Temperature	Equipment blanks
Specific Conductance	Equipment blanks
*Total Kjeldahl Nitrogen	Duplicates 10% of samples, lab matrix spike
*Nitrate as N	Duplicates 10% of samples, lab matrix spike, Field Blank, Trip Blank
*Nitrite as N	Duplicates 10% of samples, lab matrix spike, Field Blank, Trip Blank
*Nitrate + Nitrite	Duplicates 10% of samples, lab matrix spike, Field Blank, Trip Blank
*Ammonia	Duplicates 10% of samples, lab matrix spike, Field Blank, Trip Blank
*Fecal coliforms	Lab and field duplicates, Field Blank, Trip Blank
*Total coliforms	Lab and field duplicates , Field Blank, Trip Blank
*Total Suspended Solids	Lab and field duplicates, Field Blank, Trip Blank
Turbidity	Equipment blanks

*Also refer to laboratory QA manuals for lab parameters

The primary QA/QC measure conducted in the lab before commencing field work are the "equipment blanks". These tests are used to insure that equipment used during sampling does not contaminate samples. Equipment blanks are run when new equipment, equipment that has been cleaned after use at a contaminated site, or equipment that is not dedicated for surface water sampling, is used. Consult the Quality Assurance Project Plan (SOP #4) for additional details.

Check precision in the field every tenth sample by repeating the measurement three times using separate aliquots from the same sample volume. Note that these should all be recorded as the same sample and only one value included in the data analysis.
Document ability to make accurate measurements by measuring known reference samples.

5.0 REFERENCES

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Appendix A

YSI Multiparameter Probe Manual

(hard copy only)

Appendix B

Oakton pH Meter Manual
(hard copy only)

Appendix C

Hydrolab Minisone User's Manual
(hard copy only)

Hydrolab Calibration Log Sheet

Hydrolab Calibration Instructions

From Puckett (2002)

HYDROLAB MULTIPROBE CALIBRATION/MAINTENANCE LOG

	Calibration ____	Post Calibration ____	Initials:
Date:	Time:	Instrument:	Battery Voltage:
	If this is a post calibration, give date of original calibration ______		

Function	Temp. of Standard	Value of Standard	Initial Reading	Calibrated To	Comments
Specific Conductance					
pH calibrated (~7)					
pH slope (~ 4/10)					
Dissolved Oxygen					

DATA NEEDED FOR DISSOLVED OXYGEN CALIBRATION

Altitude (A)=______________feet above msl	Barometric Pressure _________ inches
Barometric Pressure (BP) Options	**Barometirc Pressure Formulas**
Barometer	Barometric Pressure (inches) ________ x 25.4 = BP ________mm
From Local Source After Correction (CBP)	BP _________ mm = CBP _______mm - 2.5 (altitude ____/100)
Estimated From Altitude Only	BP _________ mm= 760 mm - 2.5 (altitude _____/100)

For Older Hydrolabs: Table DO Value______ x ALTCORR______ x BAROCORR ______= DO Standard _______

	Calibration ____	Post Calibration ____	Initials:
Date:	Time:	Instrument:	Battery Voltage:
	If this is a post calibration, give date of original calibration ______		

Function	Temp. of Standard	Value of Standard	Initial Reading	Calibrated To	Comments
Specific Conductance					
pH calibrated (~7)					
pH slope (~ 4/10)					
Dissolved Oxygen					

DATA NEEDED FOR DISSOLVED OXYGEN POST CALIBRATION

Barometric Pressure (BP) Options	Barometirc Pressure Formulas
Barometer	Barometric Pressure (inches) ________ x 25.4 = BP ________mm
From Local Source After Correction (CBP)	BP _________ mm = CBP _______mm - 2.5 (altitude ____/100)
Estimated From Altitude Only	BP _________ mm= 760 mm - 2.5 (altitude _____/100)

For Older Hydrolabs: Table DO Value______ x ALTCORR______ x BAROCORR ______= DO Standard _______

Check previous maintenance and use; do the following before calibration:

Polish conductivity electrodes. Must be polished within the last two months or once every 15 field trips	Date:	Name/Comments:
Change pH reference probe solution. Must be renewed within last two months or once every 15 field trips.	Date:	Name/Comments:
Inspect D.O. membrane for nicks or bubbles. Must be changed within last six months or once every 15 field trips.	Date:	Name/Comments:
Change battery in 400 series sonde. Change once a year. Change internal batteries for newer generation products according to guidelines in product manual.	Date:	Name/Comments:

From Crissy Field Restoration Monitoring Program Quality Assurance Management Plan (Ward, 2004)

Hydrolab Minisonde datalogger detailed instructions for calibration, cleaning,and deployment

Post-field calibration:
* should be done shortly after retrieving datalogger from the water

- Have 5-gallon bucket ready for disposable of solutions.
- Connect data cable to end of datalogger and to Comm Port 1 on computer.
- Open Hyperterminal Application (Programs/Accessories/Communications/Hyperterminal/Hyperterminal/Minisonde)
- Check battery voltage (if < 9 volts, batteries should be replaced: 4AA batteries)
- Record appropriate notes in log throughout

Conductivity Calibration:
- Remove bottom casing from datalogger being careful not to bump sensors
- Rinse sensors with DI water: fill clear plastic vial (calibrator cup) approximately one-half to two-thirds full with DI water, attach vial to datalogger and gently rinse
- Calibrate with DI water: refill vial with water and reattach to logger
- Toggle to "Calibrate" and select "Conductivity"
- Enter Conductivity Standard (for DI water: 0)
- Rinse with Conductivity Solution
- Calibrate with Conductivity Solution (15)
- Record information in log

* Sometimes data will appear briefly on screen and then disappear. If this happens, exit to another screen and come back (e.g., go to File/Status and then ESC)

Record Dissolved Oxygen in Air:
- Remove calibrator cup
- Record reading for dissolved oxygen in air into log

Cleaning Probes:
- Use alcohol with paper towels and q-tips to clean sensors/probes
- May need to rinse with DI water if there is sand on probes

Changing Dissolved Oxygen Membrane:
- Cut Standard DO membrane into 4 equally-sized squares
- Remove O-ring and discard old membrane and solution
- Fill reservoir to top with fresh solution (2 M KCl), avoiding trapping air bubbles
- Place new membrane over the top, by gently sliding membrane on from the side (side approach seems to be better for avoiding trapping air)
- Replace O-ring
- If air bubbles appear underneath membrane, start over with fresh membrane
- If you lose solution from reservoir while attempting to replace membrane, add some more so that reservoir is full
- Rinse Hands

Downloading Data:
- Select Files/Transfer
- Answer 'yes' to "power down probes during transfer?"
- Select file for transfer (name should be yy/mm/dd according to date the file was placed in field – type in number corresponding to file name)
- Select spreadsheet (vs. print)
- Select XModem
- When you see "starting xmodem transfer" go up to "Transfer" on menu bar and select "Receive"
- Save file in J:/Crissy/Monitoring/Minisonde
- A window should pop up showing "numbers of packets received". If window does not pop up, try starting over at File Transfer
- When transfer is complete, minimize window, then check file to make sure it's there and data is OK

- Note anything unusual about data into log
- Go back to Hyperterminal and delete files if you're sure they have been downloaded and saved on J drive

Change Batteries:
Change batteries approximately once a month
- Close Hyperterminal
- Disconnect logger
- Use Allen wrench to remove top and middle casings to replace external and internal batteries.
- Replace O-rings and add lubricant if necessary
- Replace casings
- Be careful not to overtighten screws!

IMPORTANT

Allow datalogger to sit for a minimum of 6 hours (optimal 12 hours) before conducting pre-field calibration and re-deploying. This will allow the newly-replaced dissolved oxygen membrane and the probe to stabilize. During this "rest" period, datalogger should be stored with the calibrator cup attached with some moisture present (e.g., put wet sponge in calibrator cup or place a small amount of DI water in cup).

Pre-field Calibration:
* to be done on same day that logger is replaced underneath pedestrian footbridge

Set Up New File:
- In Hyperterminal, choose Files/Create
- Enter File Name (current date in yy/mm/dd format if you're returning datalogger on same day
- Enter Start Date (also todays date, but format according to hyperterminals prompts)
- Enter Start Time in PST (choose an appropriate time that allows you to finish calibrating and return the logger to the water)
- Enter Stop Date: choose date three weeks from current date (leaving logger out longer than ~ 3 weeks can lead to excessive fouling and corrupt data)
- Enter Stop Time (e.g., 235959)
- Set logging interval (one hour is the default)
- Accept all other defaults except Circulator Warmup – change this from 2 minutes to 1 minute
- Select 'no' for enable audio
- Record all in log

Calibrate:
Order isn't too important, but doing with DI water first would help clean some of alcohol off probes from cleaning.
- Rinse with DI water (0)
- Calibrate with DI water (0)
- Rinse probes with conductivity standard (15)
- Calibrate with conductivity standard (15)
- Record conductivity parameters in log
- Remove calibrator cup from probes and record D.O. in air into log
- Exit program

Return datalogger to field:
- Check tide book to get an idea how deep you need to submerge the probes to ensure that they remain under water during all tidal heights
- bring cable tie to re-suspend logger underneath footbridge

Appendix D

Equipment Log Sheets

Water Resources Instrument Log

Date	Instrument	Operator	Instrument Spot Check (✓)		Calibration (note what parameter calibrated if more than one possble)	Comments
			In Range	Out Of Range (Calibrate)		

pHTestr Instrument Log (indicate pH Testr2 or Testr3 and ID #)

Name	**Date**	**Buffer Changed (specify which buffer/s 4,7,or10)**	**Batteries Changed (specify which Testr)**	**Electrode Soaked in Buffer (✓)**	**Electrode Changed (specify which Testr)**

YSI 85 Instrument Log

Name	**Date**	**Membrane Change (✓)**	**Battery Change (✓)**	**DO Calibration**	**Conductivity cell cleaning**	**Conductivity cell spot check reading**	**Conductivity calibration**

Appendix E

Technical Support Information

Technical Support

Instrument	Supplier	Technical Support
Turbidimeter	**HACH**	Steps to help: 1. Call the Hach Service line : (800) 227-4224 2. Choose the technical support and service menue option. When you speak to the service department on the phone, they will try to determine if you need to send the instrument in for servicing. If so, make sure to get a JOB NUMBER from them. Without this you will not be able to send the product in for service. They will also give you the name and contact info of a service technician who can help you.
YSI 30,55,85	**YSI**	Chris or Johns EquipCo 1 (800) 550-5875 2100 Meridian Park Blvd Concord, CA 94520
Flo-mate 2000 flowmeter	**Marsh-McBirney**	Service Department: Tel: 1 (800) 368-2723 Fax: (301) 874-2172 Email: service@marsh-mcbirney.com
pH, TDS Testrs	**OAKTON**	OAKTON Instruments P.O. Box 5136, Vernon Hills, IL 60061, USA Tel: toll free 1-888-4OAKTON (1-888-462-5866) Fax: (1) 847-247-2984 E-mail:info@4oakton.com http://www.4oakton.com (Call before 3 pm) New Electrode Sensors: Item # WD-35624 $47.75
pH Solution	**OSH** (Orchard Supply and Hardware), **Bens**, etc.	N/A